

## CLAIMS

1. A communication device, which uses turbo codes as error-correction codes, comprising:

a turbo encoding unit which carries out a turbo encoding process on lower bits of a predetermined number in transmission data to output information bits in accordance with the predetermined number and first and second redundant bits that have been convolutionally encoded in different sequences;

10 a computing unit which carries out calculations for uniforming error-correction capabilities on the respective information bits by using the information bits of the predetermined number and the redundant bits to output the results of the calculations and the other bits in the transmission data as the results of the encoding process;

15 a first decoding unit which extracts the information bits and the first redundant bits from the lower bits of the predetermined number in the received signal, and makes a soft-judgment based upon the results of the extraction and a soft judgment output that is an output preceding by one given as preliminary information (in some cases, not given);

20 a second decoding unit which extracts the information bits and the second redundant bits, makes a soft-judgment based upon the results of the extraction and the

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soft-judgment output from said first decoding unit, and informs said first decoding unit of the results thereof as the soft-judgment output preceding by one;

a first judging unit which executes the soft-judgment  
 5 by said first decoding unit and said second decoding unit a predetermined times repeatedly, and then estimates the original information bit based upon the soft-judgment output of said second decoding unit; and

a second judging unit which makes a hard-judgment on  
 10 the other bits in the received signal to estimate the original information bits.

2. The communication device according to claim 1, wherein said turbo encoding unit includes a deinterleave processing  
 15 unit for carrying out a de-interleaving process on one group of the redundant bits that have been encoded after the interleave process to output the respective information bits and the redundant bits with the times being coincident with each other.

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3. The communication device according to claim 1, wherein Reed Solomon codes and turbo codes are used combinedly, and on the transmitting side, the turbo encoding is carried out after the Reed Solomon encoding, while on the receiving side,  
 25 the Reed Solomon codes are decoded after decoding the turbo

codes.

4. A communication device comprising an encoder that uses turbo codes with the interleave process being incorporated into the encoding process, and outputs results of the encoding process,

said encoder includes,

a turbo encoding unit which receives transmission data constituted by a plurality of bits, and carries out a turbo encoding process on lower bits of a predetermined number in transmission data to output information bits in accordance with the predetermined number, first redundant bits that have been obtained by convolutionally encoding the information bits and second redundant bits that have been obtained by convolutionally encoding the information bits after the interleave process; and

a computing unit which carries out calculations for uniforming error-correction capabilities on the respective information bits by using the information bits of the predetermined number and the redundant bits,

wherein the results of the calculations and the other bits in the transmission data are outputted as the results of the encoding process.

5. The communication device according to claim 4, wherein said turbo encoding unit includes a deinterleave processing unit which carries out a de-interleaving process on the second redundant bits,

5 wherein the respective information bits, the first redundant bits and the second redundant bits that have been subjected to the de-interleaving process are outputted with the times being coincident with each other.

10 6. The communication device according to claim 4, wherein Reed Solomon codes and turbo codes are used combinedly and the turbo encoding is carried out after the Reed Solomon encoding.

15 7. A communication device comprising an encoder that uses turbo codes with the interleave process being incorporated into the encoding process, and outputs results of the encoding process,

20 said encoder includes a turbo encoding unit which receives transmission data constituted by a plurality of bits, and carries out a turbo encoding process on lower bits of a predetermined number in transmission data to output information bits in accordance with the predetermined number, first redundant bits that have been obtained by  
25 convolutionally encoding the information bits and second

redundant bits that have been obtained by convolutionally encoding the information bits after the interleave process,

wherein, in addition to the respective information bits and the first and second redundant bits, the other bits  
5 in the transmission data are outputted as the results of the encoding process.

8. The communication device according to claim 7, wherein Reed Solomon codes and turbo codes are used combinedly and  
10 the turbo encoding is carried out after the Reed Solomon encoding.

9. A communication device comprising a decoder that decodes a received signal that has been turbo encoded by  
15 using a soft judgment,

said decoder including,

a first decoding unit which extracts information bits and first redundant bits that have been convolutionally encoded from the lower bits of the predetermined number in  
20 the received signal, and makes a soft-judgment based upon the results of the extraction and a soft judgment output that is an output preceding by one given as preliminary information (in some cases, not given);

a second decoding unit which extracts the  
25 information bits in accordance with the number of outputs

on the encoder side and the second redundant bits that have been convolutionally encoded in a method different from the first redundant bits from the lower bits in the predetermined number in the received signal, makes a soft-judgment based  
 5 upon the results of the extraction and the soft-judgment output from said first decoding unit, and informs said first decoding unit of the results thereof as the soft-judgment output preceding by one;

a first judging unit which executes the  
 10 soft-judgment by said first decoding unit and said second decoding unit a predetermined times repeatedly, and then estimates the original information bit based upon the soft-judgment output of said second decoding unit; and

a second judging unit which makes a hard-judgment  
 15 on the other bits in the received signal to estimate the original information bits.

10. The communication device according to claim 9, wherein, when Reed Solomon codes and turbo codes are used combinedly  
 20 on the transmitting side, the Reed Solomon codes are decoded after decoding the turbo codes.

11. A communication method, which uses turbo codes as error-correction codes, the method comprising:  
 25 a turbo encoding step of carrying out a turbo encoding

process on lower bits of a predetermined number in transmission data to output information bits in accordance with the predetermined number and first and second redundant bits that have been convolutionally encoded in different sequences;

5 a computing step of carrying out calculations for uniforming error-correction capabilities on the respective information bits by using the information bits of the predetermined number and the redundant bits to output the results of the calculations and the other bits in the transmission data as the results of the encoding process;

10 a first decoding step of extracting the information bits and the first redundant bits from the lower bits of the predetermined number in the received signal so as to make a soft-judgment based upon the results of the extraction and a soft judgment output that is an output preceding by one given as preliminary information (in some cases, not given);

15 a second decoding step of extracting the information bits and the second redundant bits so as to make a soft-judgment based upon the results of the extraction and the soft-judgment output from the first decoding step, thereby making the results thereof as the soft-judgment output preceding by one;

20 a first judging step of executing the soft-judgment

by the first decoding step and the second decoding step a predetermined times repeatedly, and then estimating the original information bit based upon the soft-judgment output of the second decoding step; and

- 5           a second judging step of making a hard-judgment on the other bits in the received signal to estimate the original information bits.

12. The communication method according to claim 11,  
10 wherein the turbo encoding step includes a deinterleave processing step of carrying out a de-interleaving process on one group of the redundant bits that have been encoded after the interleave process,  
          wherein the respective information bits and the  
15 redundant bits are outputted with the times being coincident with each other.

13. The communication method according to claim 11,  
wherein Reed Solomon codes and turbo codes are used  
20 combinedly, and on the transmitting side, the turbo encoding is carried out after the Reed Solomon encoding, while on the receiving side, the Reed Solomon codes are decoded after decoding the turbo codes.